Targets & UAVs Future Guidance and Navigation Systems

NDIA Targets, UAVs, and Range Operations

RD Johnson

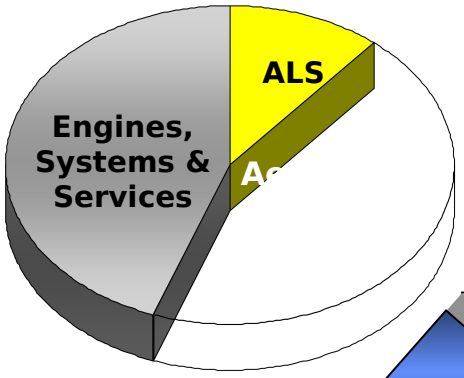
17 November 2004

Honeywell

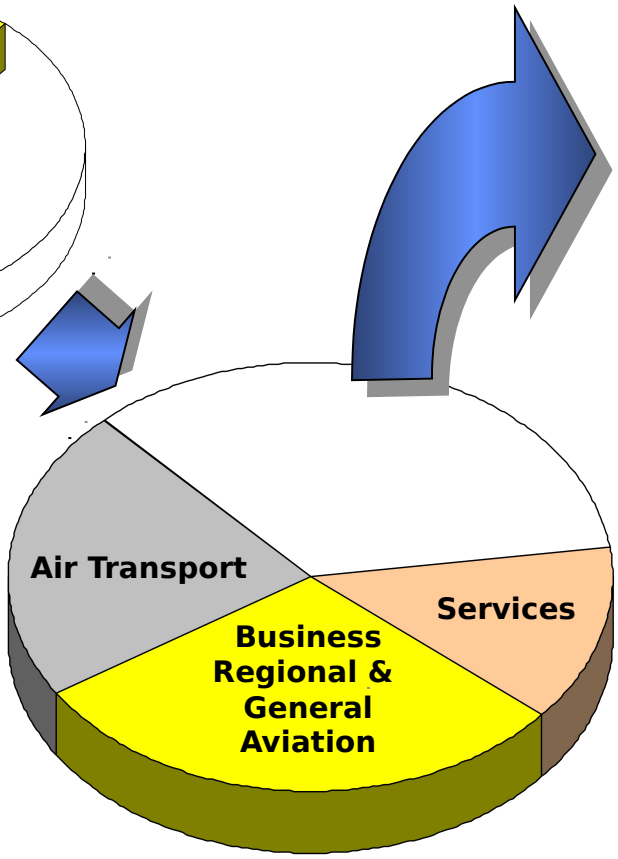
DFOISR # 05-S-0138

Honeywell Aerospace – Guidance & Control

Honeywell



Aerospac



Aerospace Electronic Systems

Defense & Space Electronic Systems

Aircraft

Missiles, UAVs Munitions

Precision Components

Surface

Space

Guidance solutions for all segments

Today's Standard Target or UAV Guidance Systems

Honeywell

- **Inertial guidance and navigation with GPS aiding**
  - **Additional aiding from air data and magnetic sensors**
- **Optical inertial sensors**
  - **Ring laser gyros**
  - **Fiber optic gyros**
  - **Resonating beam quartz accelerometers**
- **P/Y code GPS receivers**
- **Federated systems with tightly coupled software**

Low cost driven solutions

Where Are We Headed In The Future?

Honeywell

- **MEMS inertial sensors**
- **SAASM GPS**
- **Precision Terrain Aided Navigation**
- **Deeply integrated hardware & software solutions**

Enhanced performance at lower cost

Keys to Low Cost Solutions

Honeywell

- **Commonality with high volume applications**
  - **Munitions, guided projectiles, automotive**
- **Tailor for specific applications with software**
  - **Common hardware, common specifications**
- **Buy on commercial terms and conditions**
  - **Minimize data items**
  - **Configuration management by product vs program**
  - **Minimize unique testing**

Follow successful model of today's HG1700 IMU

HG1700 RLG IMU – Today's Standard

Honeywell

- On most precision weapons today
- Single hardware configuration – over 50 versions

Effective

HG1700
Inertial
Measurement
Unit (IMU)

Affordable

- Sold on commercial terms
- Targets & UAVs benefit from munitions volumes

Commonality with high volume applications

HG1700 RLG IMU Transitioning to MEMS

Honeywell

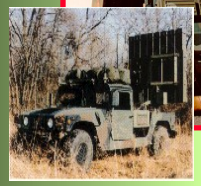
Air Force

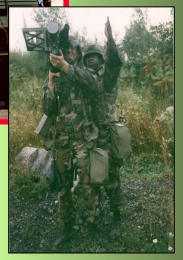
- JDAM
- WCMD
- JASSM
- GAM
- Range Pods
- EGBU-15
- Enhanced Paveway
- AGM-130
- MMT
- MINT
- MIND
- Joint MANTECH
- Small Diameter Bo

Navy

- SLAM-EI
- TacTom
- JSOW
- Harpoon
- ESSM
- Standard Missile 3
- SM2 Block IVA
- LASM
- Vandal Target
- URAP
- Range Pods
- Enhanced Paveway
- BQM-74E
- Joint MANTECH
- AGS

Army





- GMLRS
- ATACMS
- PAC3
- LOSAT
- EFOGM
- STINGER
- CKEM
- MANTECH
- Common Guidance
- EXCALIBUR
- MKV
- JCM
- NLOS-LS
- PGMM

Other

- PGB
- VT-1
- Marte
- Otomat
- Eurostinger
- LongShot™
- UCAV
- Predator UAV
- Tactical UAV
- OAV

Delivering 40,000 low cost solutions per year

DFOISR # 05-S-0138

Next-Generation Solution is MEMS

Honeywell

1999

33 in³

MEMS IMUs

60,000 ANNUALLY

PRODUCTION VOLUME

2002

16 in³

2004

4 in³

2006

2 in³

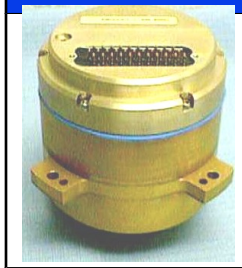
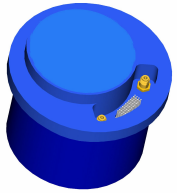
COST

PHYSICAL VOLUME

MEMS – Inertial sensor on a silicon chip

Honeywell MEMS Inertial Products

Honeywell

Product	Performance & Status	Application
 **HG1900 IMU** 17 Inch³	**Bias 12 deg/hr** **ARW 0.05 deg/√hr** **Now in production**	**Near term tactical applications**
HG1930 IMU 4 Inch³	**Bias 40 deg/hr** **ARW 0.1 deg/√hr** **Development units delivered to customers**	**Gun-hard (25,000g) applications** **Ultra-miniature applications** **Tactical applications**
 **BG1930G INS/GPS/GNU** ≤ 15 Inch³	**Proof of concept hardware built** **Ready for customer testing in 2005**	**Tactical integrated system applications**

MEMS products are in production

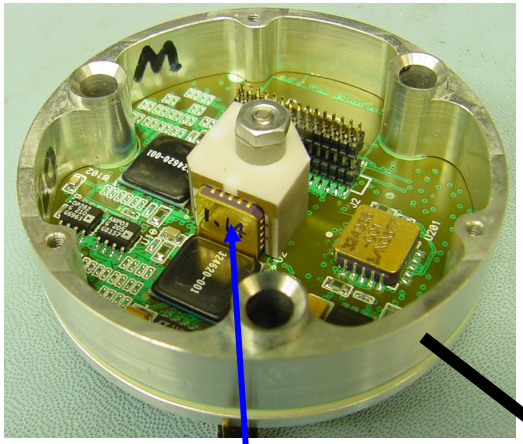
MEMS IMU Will Replace Tactical RLG IMU

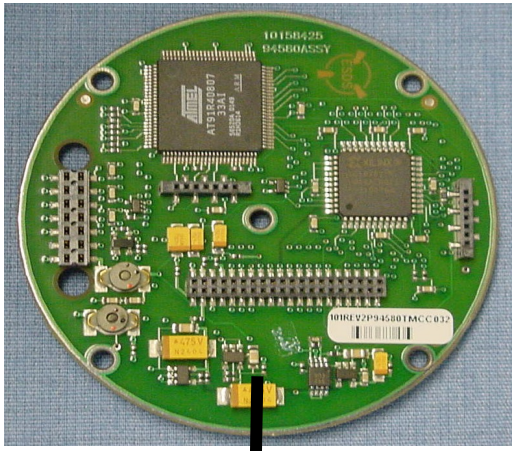
Honeywell

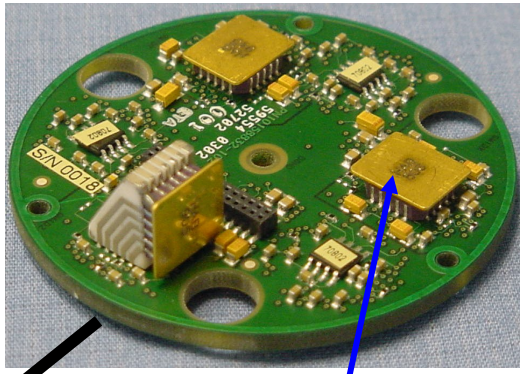
Accel CCA in Vibration Isolator

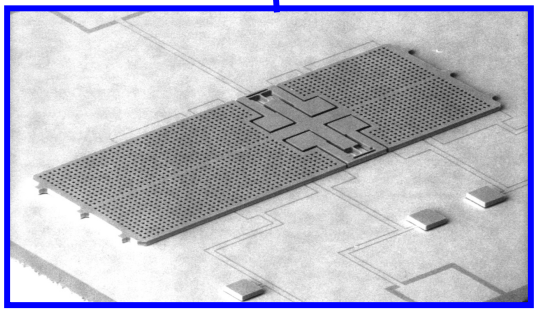
μProcessor, I/O, & Power CCA

Gyro CCA

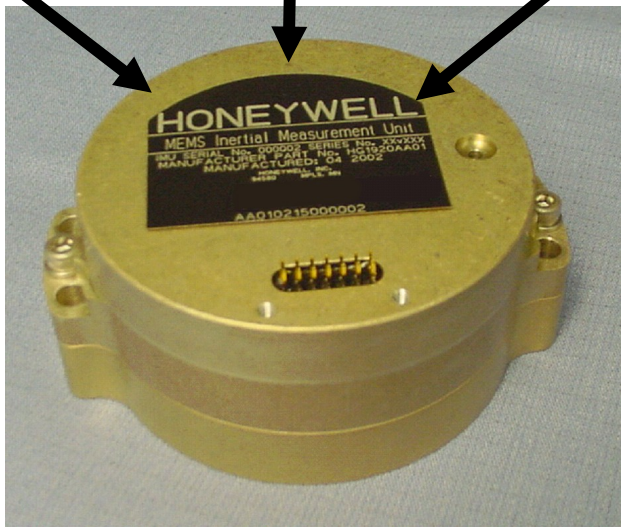


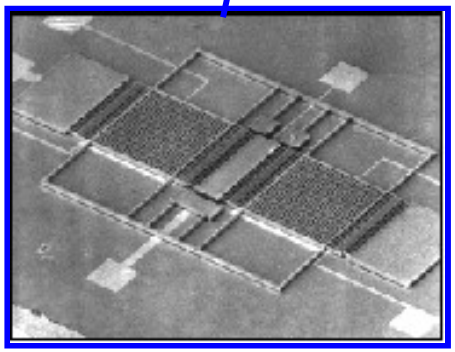






Pendulous Accelerometer



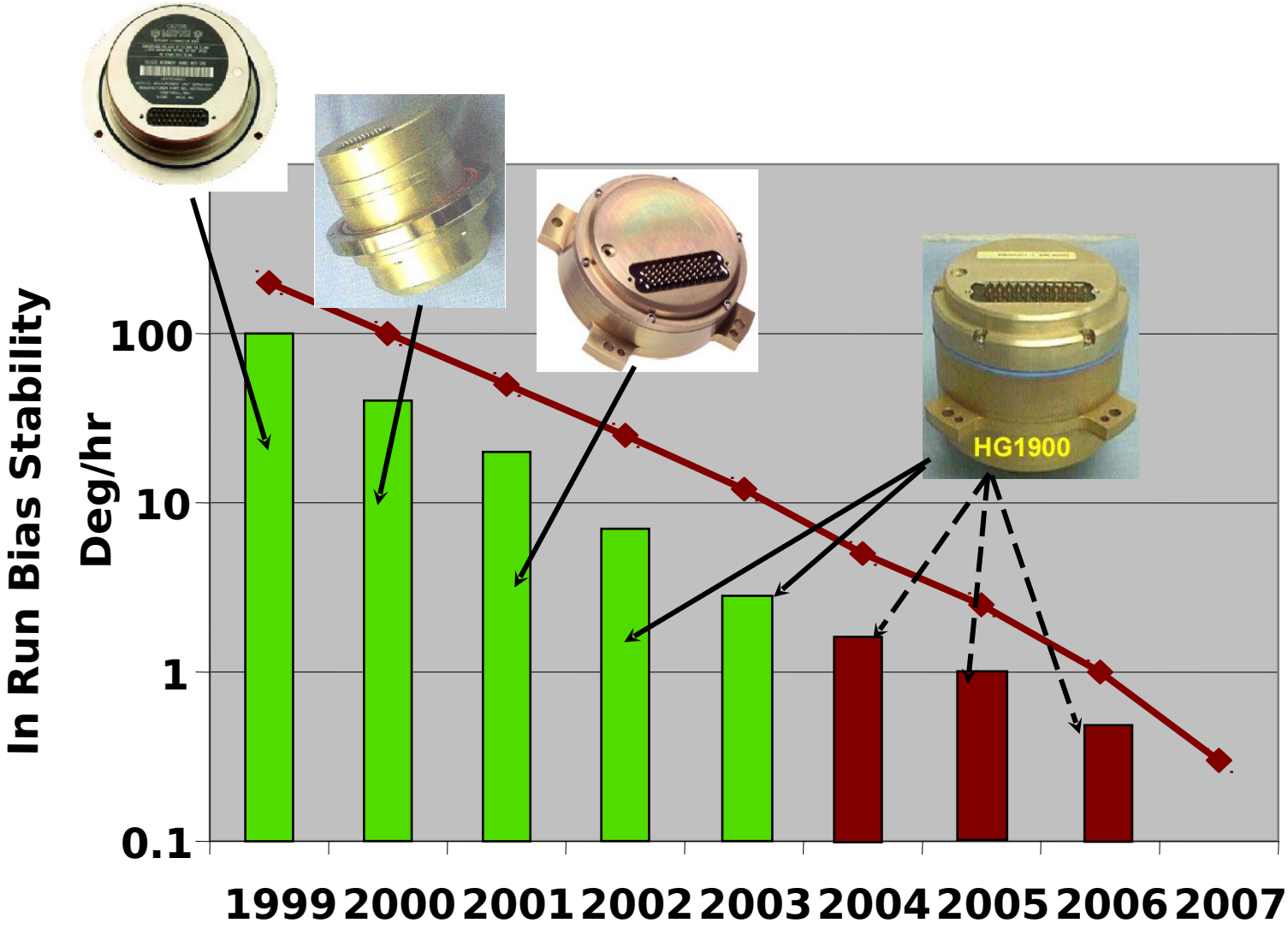


Coriolis Force Gyroscope

Driving continuous cost reduction

MEMS Performance – On Plan and Schedule

Honeywell



Approaching HG1700 full tactical performance

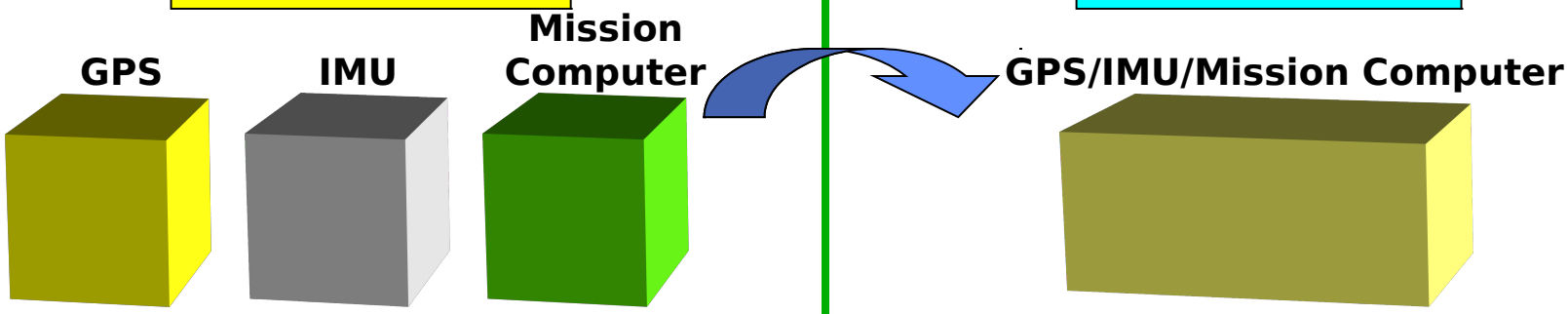
INS/GPS – What We Are Doing

Honeywell

- Integrated, Single Processor/Single Integrated Filter will reduce costs
- Lower NRE for Prime Integrators

Present State Federated

Future State Integrated



- Individual subsystem calibration and test
- Separate processors in each subsystem
- Additional overhead for I/O and each chassis

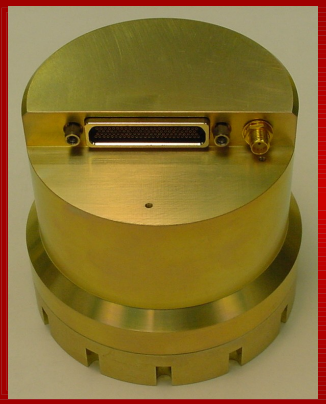
- System-level calibration and test
- Eliminates processors, power supplies, chasses, I/O
- Smaller size, lower weight and cost with enhanced AJ performance

Eliminating redundant hardware to save costs

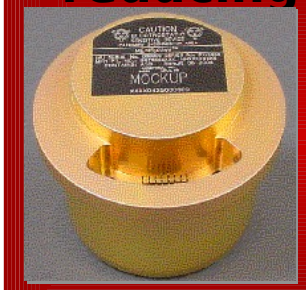
“Deeply Integrating” SAASM GPS

Honeywell

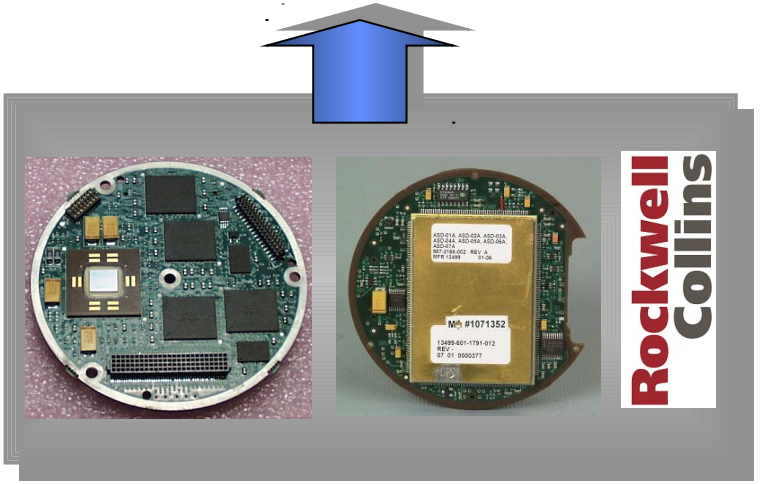
- Teamed with Rockwell Collins to more tightly integrate MEMS INS and SAASM GPS
- Shared software on common hardware - more sharing of proprietary technical data
- Enhancing anti-jam (AJ) performance while reducing size, weight and



- 28 in³ (today)
- G-hard to 10,000 g
- NavStorm GPS
- L1 only



- 15 in³ (CY’05)
- G-hard to 20,000 g
- MIPS μProcessor
- SAASM 3.3
- L1 and L2
- Integrated AJ

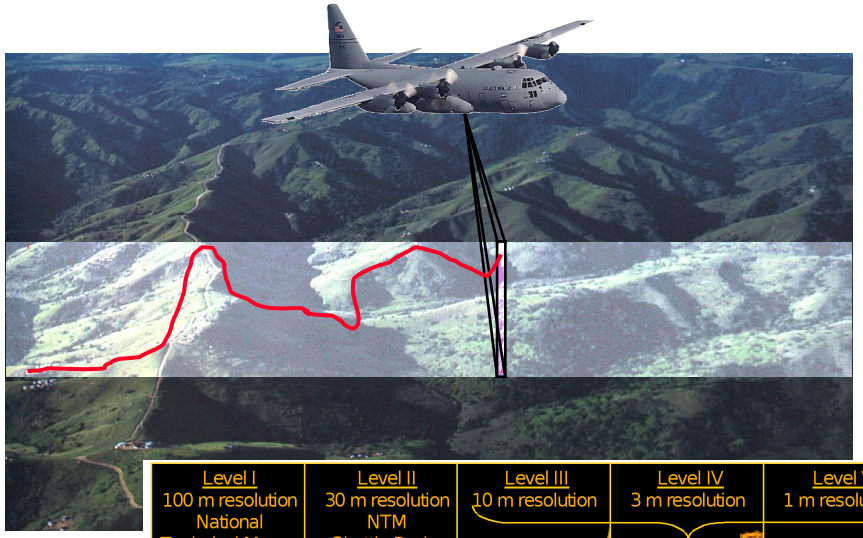


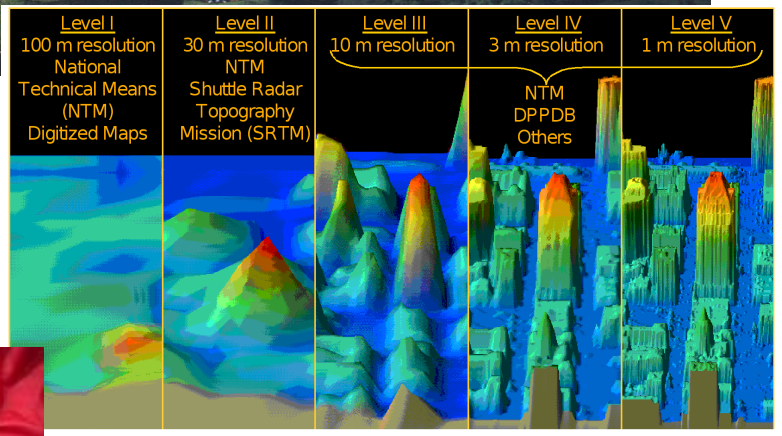
Deep integration enhances anti-jam performance

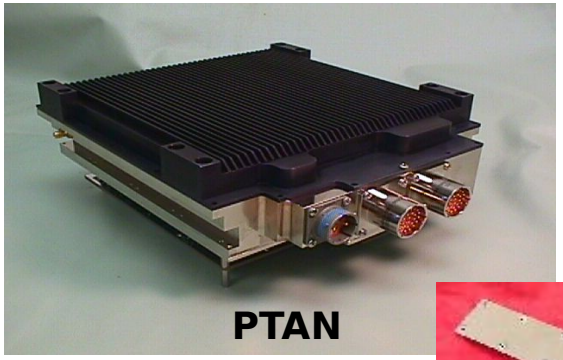
Precision Terrain Aided Navigation (PTAN)

Honeywell

- **Jamming immune navigation aid**
- **Autonomous operation**
- **All-weather capability**
- **Correlation to digital terrain map**







PTAN

PTAN Antenna

GPS accuracy without jamming susceptibility

New Technologies Enable Higher Integration

Honeywell

Micro Electro Mechanical Systems (MEMS)

+

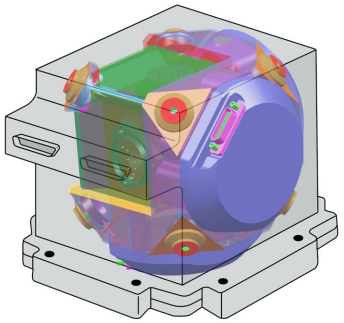
SAASM GPS, Data Links, Anti-jam Modules, Precision Terrain Aided Navigation (PTAN), Radar Altimeter, Air data

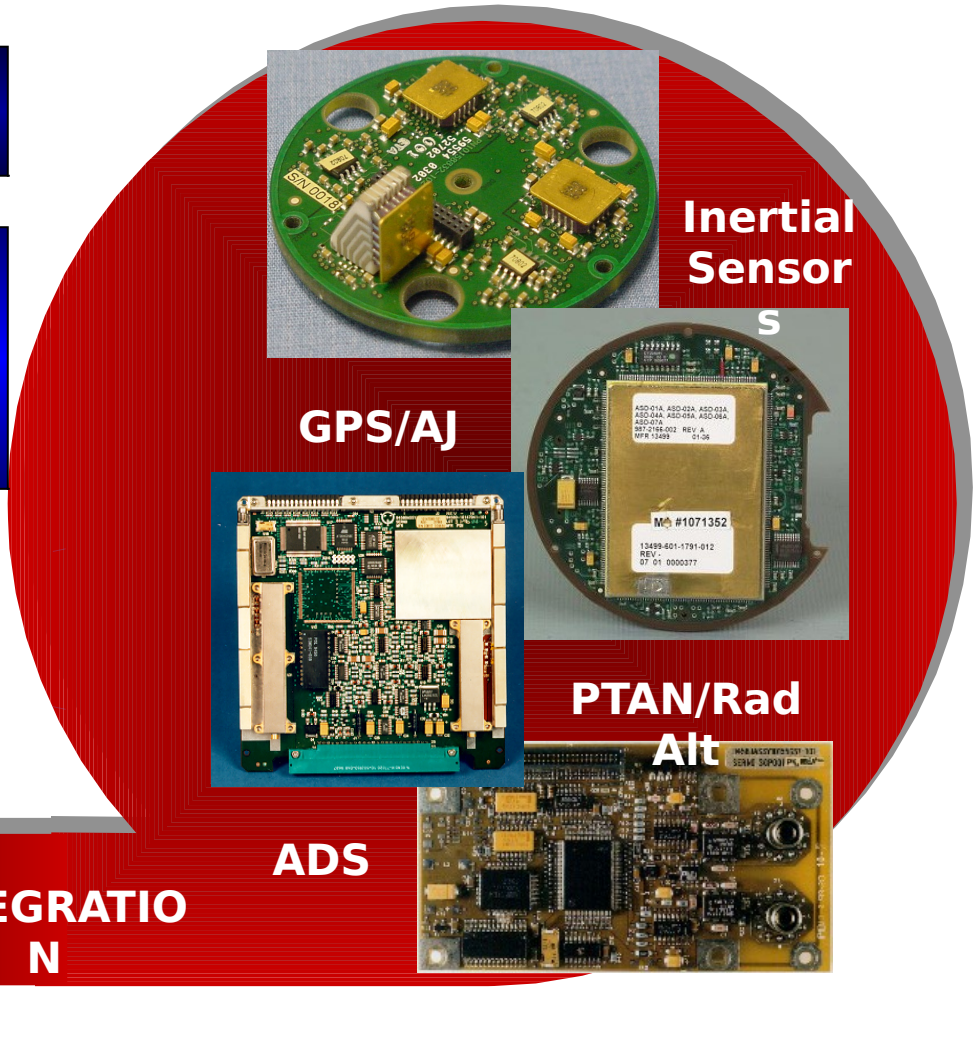
+

Modular Architectures

+

Deep Integration





Higher integration provides lower size, weight, cost

Future G&N Solutions in Development Today

Honeywell

- MEMS inertial units are now in production
- Deeply integrated SAASM GPS/MEMS IMU offer lower cost with enhanced AJ performance
- Precision Terrain Aided Navigation offers jam free solution
- New technologies enable lower cost through higher levels of integration

New solutions to enhance mission effectiveness

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www.honeywell.com